SMART APPLICATIONS FOR THE UH-60M PROGRAM

Eric F. Edwards and Will Nikonchuk

Introduction

The UH-60 BLACK HAWK Recapitalization/Upgrade Program (the UH-60M Program) was established to meet new requirements for increased lift, range, and survivability, and to address the challenges of the aging utility helicopter fleet. The UH-60M is an improved version of the UH-60 BLACK HAWK helicopter (UH-60A and UH-60L models). The U.S. Army's recapitalization/upgrade of the UH-60 platform is designed to ensure that it remains an integral part of a deployable force on tomorrow's digital battlefield.

The Project Management Office for Utility Helicopters (PMO, UH) is successfully implementing the Simulation and Modeling for Acquisition, Requirements and Training (SMART) process in the UH-60M Program. Being a legacy system, the UH-60 BLACK HAWK does not have a history of modeling and simulation (M&S) development to reference, nor does it offer many M&S lessons learned. However, M&S will be incorporated into the UH-60M Program as a method to demonstrate system effectiveness and save costs in the test and evaluation phase. Furthermore, the PMO, UH understands that investing in M&S during the risk-reduction and engineering and manufacturing development (EMD) phases will result in substantial savings for future upgrades to the UH-60 platform.

UH-60M M&S Strategy

During preparation of the Milestone B contract requirements package, the PMO, UH called on employees from the Redstone Technical Test Center (RTTC) and the U.S. Army Aviation and Missile Command's Research, Development and Engineering Center (AMRDEC) to map out an M&S strategy. As a result, the UH-60M Simulation Support Plan (SSP) was developed to define M&S strategy and present a path to implement M&S in the UH-60M Program.

The U.S. Army developed the SMART process in response to a DOD-level directive to adapt Simulation Based Acquisition (SBA) for all future system acquisitions or major system upgrades. SMART expands SBA by not only including M&S in the acquisition phase of the system life cycle, but by also using it in the training and requirements definition phases.

M&S has been used increasingly throughout the design, analysis, and testing of other aircraft and missile systems that are under development. The application of M&S in the UH-60M Program supports this initiative through the effective use of state-of-the-art technology.

The UH-60M Program is in a risk-reduction phase to further define the system's baseline. As such, the government and Sikorksy Aircraft Corp. (SAC) are conducting trade studies to answer programmatic and baseline design issues prior to entering the integration and qualification (I/Q) phase. The I/Q phase replaces EMD in the UH-60M Program. During the risk-reduction phase, the user has many opportunities through the combat developer to provide feedback on baseline configuration changes to the SAC design team and the PMO, UH. Early user demonstrations (EUDs) will support this user/designer interface.

PMO, UH has also encouraged the use of M&S in the UH-60's design and modernization. The PMO, UH believes that EUDs offer an early opportunity to introduce M&S into the UH-60M Program. One benefit of M&S recognized by the PMO is the ability to rapidly prototype components, subsystems, and eventually the UH-60 system.

Incorporating engineering-level modeling and simulation as prototypes prior to bending metal on a production line is not new to industry or the military. Computer-based models developed for engineering analysis may transition to their hardware subsystems as physical mock-ups. Virtual prototypes capable of easy reconfiguration are an example of M&S used in this transition. Reconfigurable prototypes can be tested under simulated conditions. This allows the design team to evaluate their prototypes in virtual environments.

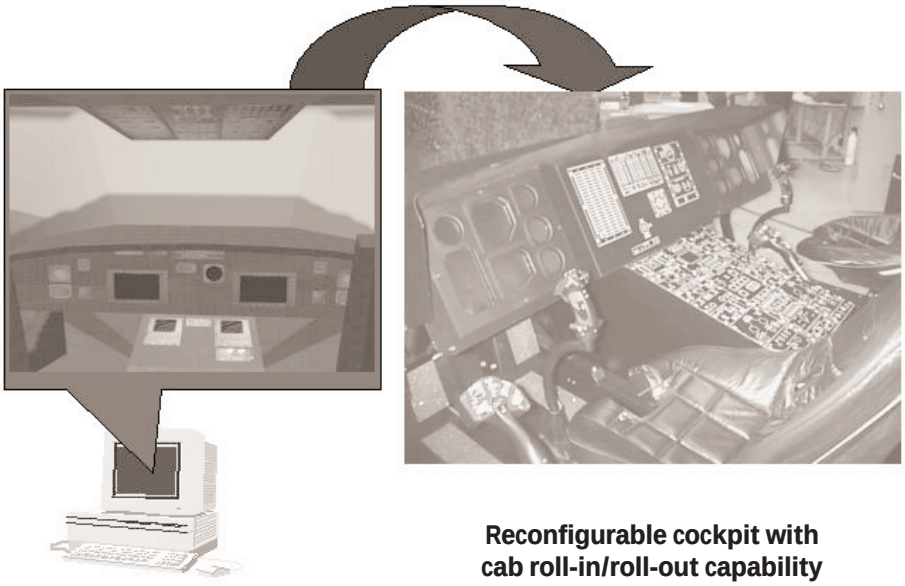
CADCab

UH-60M cockpit design changes are primarily focused on upgrading the controls and displays. PMO, UH will analyze the design changes using virtual prototypes, a reconfigurable cockpit, and a systems integration laboratory. Design changes and the upgrade process are supported by CADCab. CADCab is a Unix-based approach that uses high-end graphics and computer-aided design (CAD) tools to rapidly prototype the proposed UH-60 cockpit configurations within a virtual UH-60 cabin. CADCab provides a 3-D perspective to better assess subsystem spacing. Computer-based prototyping allows for rapid side-by-side analysis of many different configurations. Synthetic imagery allows the design team to properly define control and display requirements and, to a limited degree, assess system-level performance. Better dimensioning leads to a better form and fit analysis for many of the proposed changes to the cockpit and to the associated flight instruments.

Pilot input enhances the form and fit analysis of an instrument panel redesign. Pilot actions can be replicated, demonstrated, and measured when functionality is added to the instruments. A functional capability is possible with this virtual environment because the synthetic instruments are directly coupled with a UH-60 flight model. Current risk-reduction trade studies such as the "4 versus 2" multifunction display (MFD) will benefit from this analysis.

Reconfigurable Cockpit

The reconfigurable cockpit is the pilot's interface with the virtual CADCab instruments. The numerous cockpit configurations developed on the CADCab are ported to the reconfigurable cockpit, which is open-seated with four flat panel displays (FPDs) across the instrument dash panel. Another FPD is



CADCab

Reconfigurable cockpit with cab roll-in/roll-out capability

located on the lower console. The FPD's touch-sensitive screen can display virtual MFDs and their associated pages, any number of primary flight instruments and gauges, as well as general-purpose switches. The reconfigurable cockpit has collective, cyclic, and tail-rotor control pedals that are linked to the flight model, allowing the pilot and co-pilot to fly through simulated environments. The cockpit is mounted on lockable casters that allow it to roll in or roll out of a 150 by 45-degree field-of-view dome and projector system. This allows the cockpit to interactively maneuver in any terrain box and with any number of different scenarios displayed onto the projector system.

The CADCab/reconfigurable cockpit approach was developed to address proposed modernization changes to the UH-60 BLACK HAWK during their EUDs. The CADCab/reconfigurable cockpit approach is a low-cost alternative to cockpit hardware changes, hardwiring, or an extensive software development program prior to preliminary design review (PDR). This approach leverages the hardware and software investments made by other programs within the U.S. Army Aviation and Missile Command.

Early User Demonstration

Early user demonstrations consist of three events scheduled throughout the risk reduction and I/Q phases of the UH-60M Program. EUD1 will use CAD and computer-generated imagery to facilitate user and designer communication and analysis during risk reduction and prior to PDR. EUD1 allows pilots (users), designers, and PMO representatives to identify potential user issues and design solutions based on current configurations. EUD1 will also provide an opportunity to define the metrics necessary to measure situational awareness (SA) resulting from information presented to the pilot; establish measures of effectiveness/performance for future SA design and analysis activities; and facilitate initial human factors engineering of candidate instrument panel configurations. EUD1 is expected to provide many lessons learned for EUD2.

EUD2 will capture user feedback on design changes that have been incorporated and approved in preparation for critical design review.

SIL

EUD3 will involve examining hardware and software components on a fully instrumented UH-60M cockpit (aka the System Integration Laboratory (SIL)) located in AMRDEC's Software Engineering Directorate. The SIL contains a fully instrumented UH-60Q cockpit. Once the UH-60M's baseline configuration is defined, the SIL will be integrated with UH-60M upgrade components.

The cockpit will be capable of being stimulated by synthetic environments and simulated control responses. This will allow the user, combat developer, and test and evaluation community to acquire data that will eventually fully support a system analysis and assessment of the digitization and SA capability. During EUD3, the mature SIL cockpit will allow the user to access and interact with the UH-60M cockpit components and will allow user and pilot dialogue, feedback, and evaluation to continue without the delay of obtaining airworthiness and safety releases for the actual aircraft.

Conclusion

PMO, UH is implementing M&S as a design and analysis tool and as a means to communicate user requirements. The SMART approach is being embraced in the UH-60M Program as reflected in the EUDs. As the program progresses, the UH-60M SSP will provide guidance for M&S applications. Other opportunities for M&S applications and future program cost savings are expected.

ERIC F. EDWARDS is the Lead Engineer for the UH-60M Program within the PMO, UH. He holds a bachelor's degree in aerospace engineering from the University of Alabama and a master's degree in acquisition and contract management from the Florida Institute of Technology. He is a member of the Army Acquisition Corp and a YG01 member of the Competitive Development Group.

WILL NIKONCHUK is the STEP IPT Lead for the UH-60M Program and works in AMRDEC's System Simulation and Development Directorate. He graduated from the U.S. Military Academy with a B.S.E.E. and holds a master's degree in industrial and systems engineering from the University of Alabama in Huntsville.
